ECTS AND METHOLOGICAL EXPERIENCES IN TELECOMMUNICATIONS SYSTEMS ENGINEERING FOR THE ADJUSTMENT TO EUROPEAN SPACE FOR HIGHER EDUCATION

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Abstract

In this paper we present a summary of the actions in educational innovation perform in the subjects of 3th year of Technical Engineering in Telecommunication Systems, as well as the results and conclusions obtained. These activities has been carry out in the frame of a Educational Innovation Project granted by the "Universidad Politécnica de Madrid" in the process in implementing the European Higher Education Area, and to improve the education quality. The main activities and developed materials are around the organization and coordination of the subjects, and on the utilization of methodologies and educational tools centred on the learning. Besides the academic results and the comparison with other subjects there will be included the opinions of pupils and teachers.

Keywords

Educational innovation, European Credit Trasfer System (ECTS), Educational Resources, European Space Higher Education, Open Knowledge.

1. INTRODUCTION

This document provides a summary of the activities and the results obtained by the Group for Educational Innovation in Telecommunications Systems in the framework of the process of implementing the European Higher Education Area and improving the quality of education during the two last academic years.

The main actions carried out were as follows:

- Organizational procedures, structuring and coordination of the subjects included in the project.
- Development of structures and contents for serveral subjects for use in b-learnig, e-learning and the publication of two subjects in the UPM OpenCourseWare.
- Use of teaching methodologies and assessment geared to learning.
- Development of simulation programs and other materials for use as teaching aids for distance learning as well as practical tools for virtual laboratories. Some of these teaching materials have been presented in several papers at national and international congresses.

We shall show the most meaningful results of this project. Both in what it refers to the academic results as well as his comparison with those of previous courses and with the reached ones in other subjects carried out with classic methodology. We will also present the results of the study of the times of dedication by the students and of the opinion of these on the followed methodology. All this information has been generated across a constant follow-up of the activities and by means of surveys. Finally the principal conclusions of the professors participants in the project will be presented.

2. EDUCATIONAL INNOVATION ACTIVITIES

One of the usual problems that we can found at the university is the lack of both detailed and structuring planning of the subjects taught. In most of them there is a lack of well formulated targets (these are limited, if any, to the merely description of the contents), there is no clear statement of the used material, the chronological presentation of the topics or even of the procedures of assessment.

This information is usually included in summary form in the academic planning of the departments and is exposed orally on the first day of class, being usual the non-attendance of a good number of students at the presentation of the subject. Additionally, there is often no procedure for coordination between any subjects of the same course with the exception of the schedules and final exams. With this situation in mind, one of the first objectives of the proposed educational innovation project carried out during the two last years has been to establish procedures for organization, structuring and coordination among the subjects of 3rd year of Technical Telecommunication Engineering taught by professors of the Group of Educational Innovation.

Firstly, to estimate the load on ECTS, an analysis of the dedication that was necessary in order to pass each of the subjects was carried out. It was subsequently conducted an initial review of the timing of the subjects to include learning activities by students, sequencing between the theory classes and laboratories, continuous assessment procedures, and so on. This planning was embodied in an Excel worksheet designed for this purpose in order to have a single format for this planning.

Based on this analysis and this methodology, various meetings were held in order to perform a coordinating and managing the activities of the different subjects avoiding so an excessive workload or the accumulation of weekly exams or other evaluation elements. Figure 1 illustrates the programming of the subjects in this format.

GRUPO DE INNOVACIÓN EDUCATIVA EN SISTEMAS DE TELECOMUNICACIÓN — Horas Totales semana — Horas totales cuatrimestre

Día	Calendario: Mes	Semana	RADIOCOMUNICACION: Tema	Lección/Exposición	Actividades	H	Trabajos/evaluaciones	H	HTS	S.TELECO: HTS	TECNOLOGIAS DE RADIOCOMUNICACIÓN: Tema	Laboratorio	H	HTS	H (Total)
							Entrega por escrito								
2		2			Documento de trabajo en grupo. Jigsaw	1	P 8-10. Estudio, Dudas	1			1				
4			1	E.L, Onda Superficie y Ionosférica, (P 8-18)	Ejercicio Resuelto. A3,4		P 19-28. Estudio, Dudas	2	6	4	1			8	31
9		3	1	Atmosfera Refracción (P 19-28)			P 29-44. Estudio, dudas	1			2				
11	Octubre		1	Absorción. Gases y lluvia. (P29-42/44)	Ejercicio Resuelto. A 5,6	0,5	P 45-50. Estudio, dudas	2	6	6				7	34
16		4	1	Influencia Tierra Reflexión (P 45-50)			P 51-58. Estudio, dudas	1			2	P1: Conmutador PIN			
18			1	Influencia Tierra difracción (P 51-58)	Ejercicio Resuelto A 7	0,5	Ejercicios P 6-13 Grupo. -->S6	6	10	4	2			10	39
23		5	2	Radioenlaces (R 19-26)	Planificación Radienlace (Grupos)	0,5	Planificación Radienlace (--> S9) Tareas, Mapas	4			2	P1: Conmutador PIN	2		
25			2	Equipos (R 1-18)			R 27-31. Estudio, dudas	1	6	10	2	Simulación P1		12	43
30-oct		6	2	Potencia (R 27-31)			P Radienlace (S9) RadioMobile, Mapas	2			3	P1: Conmutador PIN	2		
1					Planificación Radienlace		P Radienlace (S9). Calc.	2	5		5 y 6	Realización circuito P1		11	16
6		7	2	Desvanecimientos (R 32-40)	Proponer ejercicios (1y 2 comunes, 3 diferente)		Ejercicios R.E (--> S8)	2			7	P1: Conmutador P	1	11	
8			2	Cálculos de calidad (R42-50) (sin detalles)	Ejercicio resuelto RE	0,5	P Radienlace (S9). Proyecto	2	7			Medida P1			18
13	Noviembre	8	2		Resolución ejercicios	1	Ejercicios R.E (--> S8)	2			8	P2: Filtro L. Acopl	3	14,5	
15			3	C.Satélite. Orbitas Cobertura (S 1-15)			Estudio Temas I y II.	5	10			Simulación P2			24,5
20		9	3		Examen Temas 1 y 2	1					9	P2: Filtro L. Acopl	3	13	
22			3	Segmento espacial y terreno. (S 19-36), 16-18	Proponer ejercicios (1y 2 comunes, 3		S 37-56. Resumen, dudas	2	5		10	Realización circuito P2			18
27		10	3	TAM (S 37-56)	Ejerc. Apuntamiento	1	S 57-64. Estudio, dudas	1			10	P2: Filtro L. Acopl	1	13	
29			3	Balance del enlace, Rec. UIT (S 57-64)	Ejercicio resuelto	0,5	Ejercicios Sat (--> S13)	2	6		10	Medida P2			19
	H Totales					10		64	100	141			22	170	719

Figure 1. Spreadsheet for planning and coordination of the subjects.

It was also generated a Excel spreadsheet for tracking and controlling the time of dedication in the various subjects and activities spent by the students and the times of dedication to innovation activities spent by the teachers. Such actions had not been yet carried out so far in the subjects of this degree, and as far as we know, this is not usual, given the difficulty of getting agreement among the teachers and their procedures involved and the organization and structure of the subjects. However, this type of organization and coordination of tasks and processes of learning and assessment are of vital importance to achieve a continuous work and approachable by students.

Once it was established the programming, the guides of the various subjects were made, with redefinition of the objectives and adequacy of teaching methods and assessment methodologies towards procedures based on learning. In the student's guide are included topics such as: the type of subject, their current credits weight as well as their correspondence (estimated) in terms of ECTS; the prerequisites for the proper monitoring of the subject; goals of competitiveness as well as cognitive that be want to achieve; the topics to develop and the activities to be carried out, being under time control in both cases; the teaching methods and evaluators to be used, specifying dates for potential assessment, and the literature and material support available.

Regarding the educational methodologies, these have been orientated fundamentally to the accomplishment of activities on the part of the students (directed study, practices of laboratory, resolution of problems, exercises and cases); shortening the time devoted to the expositive lectures and using as long as possible the working groups, both informal as well as formal. This type of operation has been traditional in the classroom and practical activities carried out in laboratories. However, it is not easy to run this type of methodologies for theoretical lectures, due to the initial feeling of loss of time and lack of preparation for group work, both by students and by teachers.

As far as the assessment is concerning, generally a mixed procedure has been used: taking into account the continuous activities (works; resolution of exercises and cases, realized of individual form and in group, participation in the platform, attendance at classes, an so on), as well as the completion of two partial evaluations, through written examination, consisting of the resolution of several exercises. To each of these activities a weight has been granted in the final qualification, known by the students from the beginning of the subjects. The abandonment or not overcome the activities of continuous assessment or partial evaluations, It will imply the need to go to the final examinations of the subject in the official summons to be able to pass this one.

During the imparting of the subjects along both semesters, there have got improved the educational available materials and new others have been realized: sketches of practices, documentation of support, links and tools of simulation. All these materials, together with the educational guides have been uploaded to the virtual environment of learning (LMS) based on the platform Moodle. Also the different tools of this environment have been used for organizing and helping in the learning process of the students: schedules; forums for news, doubts, tutorships in network; delivery of exercises, cases and tasks in network, etc. In short, both for the educational aspects and for the assessors there has been used a methodology of mixed learning, "B-learning", in person as well as distantly. This type of solution has been demonstrated as an important element of support and organization in the study and the follow-up of the subjects, being very well valued by the students. [1,2]

Another interesting experience has been done in a course on Telecommunications Policy and the Information Society, where it has developed a strategy of e-learning education with innovative teaching methodologies [3], including the active participation of students through online discussion forums, a wide range of teaching material and the use of templates and categories for assessment, with very good results [4].

From the contents developed during previous courses, and from the planning carried out in the subjects of Radio communication and Mobile Communications, These have been included in the initiative " Open Course-Ware " set up by Universía in collaboration with the UPM. The figure 2 shows a snapshot with an example of the contents of these subjects.

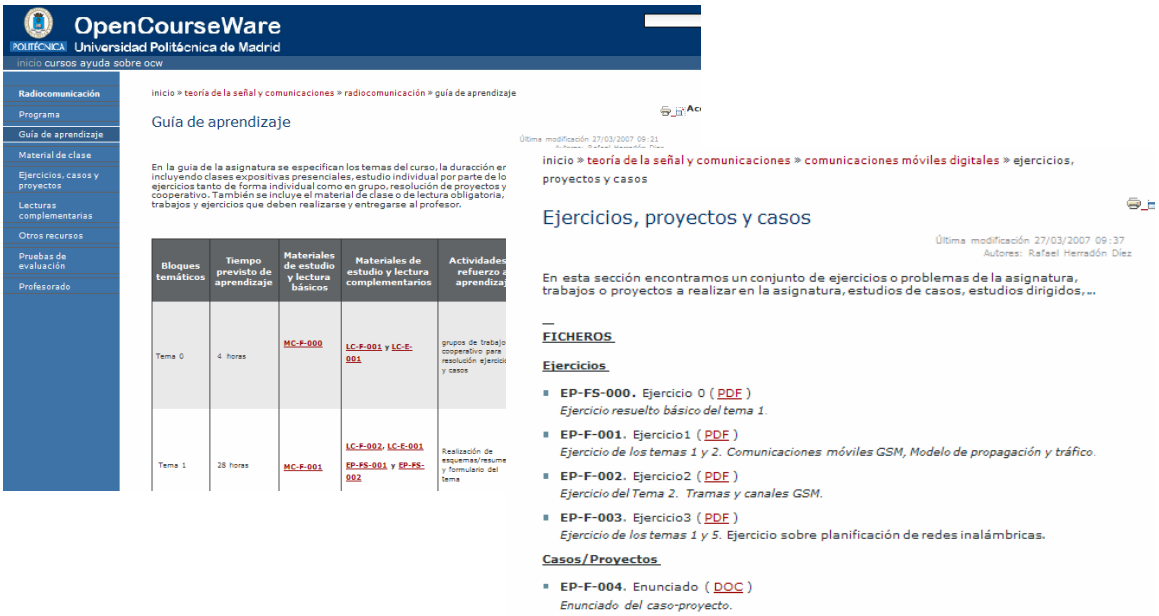

Figure 2: Subjects hosted in OCW-UPM.

Another one of the initial goals of the project of educational innovation was the development of simulation tools and different didactic materials for his utilization as supporting elements to the learning, both in the method of blended learning "b-learning", as in systems of pure e-learning through distance learning. The programs and applications elaborated to facilitate the development and the comprehension of theoretical aspects and for the preparation practices in virtual laboratories have been presented in different congresses [5-7].

3. ACADEMIC RESULTS.

Concerning the academic results reached by the students, we can highlight those who have been obtained during the first semester. The relevant results of the 2nd semester have not changed much, fundamentally due to that this is a four-month period in which the Career End Project is included, which usually is finished some time later, and has been subject to procedures of continuous assessment during the last academic years. During the 1st semester period it is worthy to observe a meaningful improvement of the rate of success (percentage of passed over presented to the exams), of almost 15 percentage points and an increase of almost 9 percentage points in the rate of yielding (percentage of passed over matriculated people), in the subjects included inside the Project of Educational Innovation and on the average of the previous courses. Nevertheless, there exists also a widespread increase of the rate of abandon, (almost 6 points in average), surely due to the need for a continued effort.

On the other hand it is necessary to highlight the behaviour of the results in the subject of Radio communication, where procedures of innovation were already tried out during the previous course. In that academic year, Radiocomunication showed some spectacular results, at the cost of a worsening of the results in the rest of subjects. Also it is necessary to emphasize the excellent results obtained in the subject of Telecommunication Systems after the employment of procedures of continuous assessment. This information is presented in more detail in the following graphs, where appears the parameters previously mentioned, together with the average mark of the subjects of the first four-month period, included in the project of Educational Innovation during the last courses. To compare, is also shown the information of another subject, “Communications Networks”, of the same course and four-month period, in which is practised a traditional methodology of evaluation and teaching.

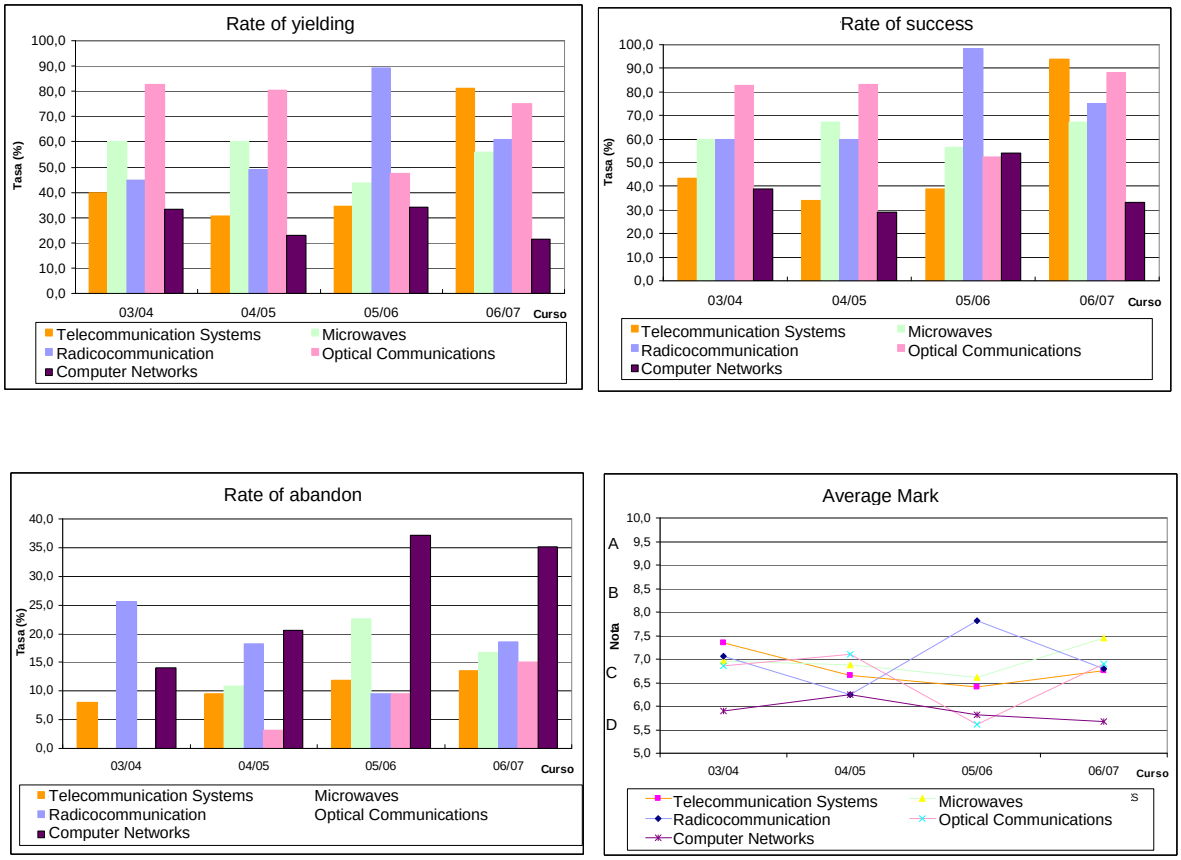

Figure 3. Results of the subjects

4. ASSESSMENT BY THE TEACHERS AND STUDENTS

In general, the students as well as the teachers have proved to be satisfied with the obtained results, but they show disagreement with the load of work and the continuity of the same one. The need to realize deliveries very often, the continued follow-up of the activities of the students and the procedure of coordination among subjects, has generated certain uneasiness and sensation of oppression both in the students and also in the teachers.

The aspect most highlighted on the part of the pupils of the whole project of innovation has been the utilization of the virtual environment of learning based on Moodle as an element of helping to the study and follow-up of the subjects.

On the other hand, the attempt of assessing accurately the time of work devoted by students and teachers has been a failure. With exception of the subjects of Radio-Communication and Mobile Digital Communications, where already it had been tried previously and where there was not evaluated any work that was not accompanied by the time dedicated to the same one; in the rest, it has not been possible to assess the dedication accurately. Nevertheless, so much the approximate data obtained by means of surveys at the end of the subjects, as the most exact of both previously mentioned, shows that the dedicated time do not exceed in much the foreseen ones. In the following figure two graphs appear, the first one shows the different activities realized (assistance to class, working in groups, exercises, tutorships, etc), while the second makes reference to total load in hours for every student and his (her) relation with the final mark. In this latest chart we can see in most cases a fairly high correlation between the final and gained the hours spent

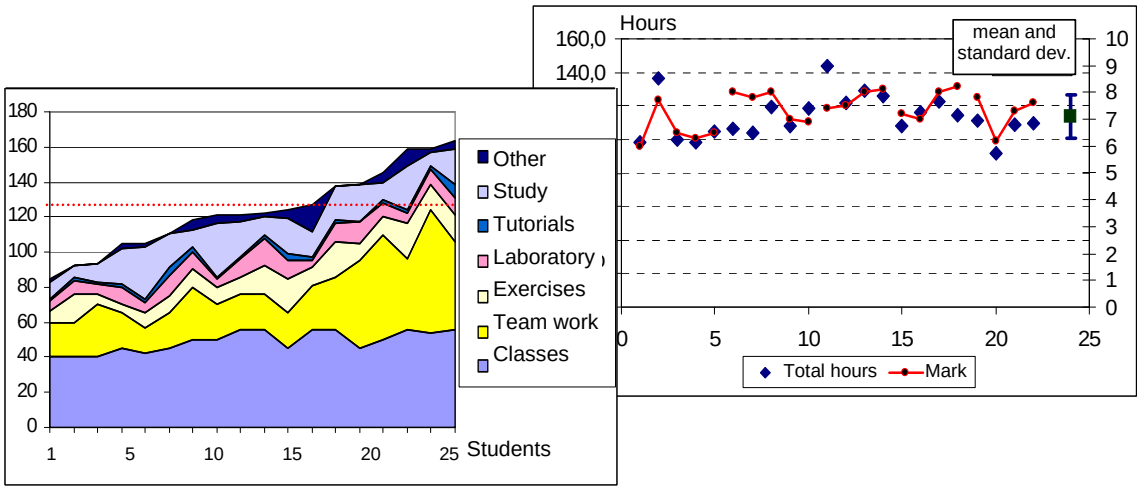

Figure 4. Hours dedicated by the student. a) Activities b) Relation with the final mark..

5. CONCLUSIONS AND FUTURE ACTIVITIES

We want firstly to highlight that the experience has been positive enough. We think it is essential the idea to modify the approaches and current methodologies towards an education centred on the learning and the continuous work of students and teachers, specially if we bear in mind that the academic results, if not spectacular, they are better than in the traditional system. Regarding the negative aspects of the experience carried out, they are centred fundamentally in the time of dedication. This can be due to the lack or loss of the custom of doing a daily work by the student and also is a result of trying to follow more subjects of those who are reasonable in an academic year. As regards the working load on the part of the involved teachers, really it is very high. The analyses carried out show that the time devoted for the preparation and follow-up of the classes is much larger compared with a classic methodology (this without counting the time dedicated to the generation of materials, or update of the subject). In a coarse first approximation it is possible to estimate a load of about two hour of dedication to the preparation and follow-up for every hour of class. This high volume of work lead to discouragement to the involved teachers, specially when it is not a too recognized task and these pedagogical methods are criticized on the part of other teachers.

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